REMARKS

Claims 1-27 are all the claims presently pending in the application. Claims 1, 10 and 19 have been amended to more clearly define the invention. Claims 1, 10 and 19 are independent.

These amendments are made only to more particularly point out the invention for the Examiner and not for narrowing the scope of the claims or for any reason related to a statutory requirement for patentability.

Applicant also notes that, notwithstanding any claim amendments herein or later during prosecution, Applicant's intent is to encompass equivalents of all claim elements.

Entry of this §1.116 Amendment is proper. Since the Amendments above narrow the issues for appeal and since such features and their distinctions over the prior art of record were discussed earlier, such amendments do not raise a new issue requiring a further search and/or consideration by the Examiner. As such, entry of this Amendment is believed proper and Applicant earnestly solicits entry. No new matter has been added.

Applicant gratefully acknowledges that claims 13-18 would be allowable if rewritten in independent form. However, Applicant respectfully submits that all of the claims are allowable.

Claims 1-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the Applicant's admitted prior art (hereinafter "AAPA") and Yamakita et al. (U.S. Patent Application Publication No. 2002-0154262).

This rejection is respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

A first exemplary embodiment of the claimed invention is directed to an in-plane switching type liquid crystal display unit which includes a pair of substrate structures and a liquid crystal layer. The pair of substrate structures have at least plural pixel electrodes and a common electrode on one of the substrate structures. The liquid crystal layer is sandwiched between the substrate structures and has a splay elastic coefficient which has been selected to be within the range of 6 to 25 pico-newtons for improving the luminance of the in-plane switching type liquid crystal display unit.

A second exemplary embodiment of the claimed invention includes a liquid crystal layer having a bend elastic coefficient which has been selected to be within the range of 5 to 20 pico-newtons for improving the luminance of the in-plane switching type liquid crystal display unit.

A third exemplary embodiment of the claimed invention includes a liquid crystal layer having a splay elastic coefficient and a bend elastic coefficient which have been selected such that a square root of the product of the bend elastic coefficient and the splay elastic coefficient within the range of 5 to 20 pico-newtons for improving the luminance of the in-plane switching type liquid crystal display unit.

Conventional in-plane switching type active matrix liquid crystal display units experience problems of low luminance which is derived from a low aperture ratio and non-transparent comb-like electrodes (page 2, lines 3-10). One conventional approach to this problem is to provide pixel electrodes with waved teeth. However, the fabrication process for this method is complicated (page 2, lines 11 - 17).

The inventor discovered that low luminance is due not only to the low aperture ratio

but also a weak anisotropy of refractive index of the liquid crystal layer. In particular, the inventor realized that a portion of the local electric field in the liquid crystal of the pixel is vertical (normal) rather than parallel to the substrates (page 3, lines 1 - 11).

As shown in Fig. 2, the local electric field in the periphery of the common/pixel electrodes 53/58 is not parallel to the substrate 300. Rather, it is more vertical. The liquid crystal molecules 370 in this portion are arranged in a spray pattern which lowers the luminance. While conventional display units may have compensated by adjusting the twist elastic coefficient, neither of the splay elastic coefficient nor the bend elastic coefficient were taken into account. Therefore, the present invention is directed to reducing the affect on luminance by selecting the splay elastic coefficient and/or the bend elastic coefficient for the liquid crystals so that the luminance of the liquid crystal is improved. (page 7, lines 4-5).

II. THE PRIOR ART REJECTION

Regarding the rejection of claims 1-27, the Examiner alleges that the Yamakita et al. reference would have been combined with the Applicant's Admitted Prior Art (AAPA) to form the claimed invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, the references are directed to completely different matters and problems.

Specifically, the AAPA is directed to the problem of low luminance derived from a low aperture ratio and the non-transparent comb-like electrodes (page 2, lines 3 - 8) and to

avoid the complicated fabrication process of one conventional attempt to solve this problem (page 2, lines 11 - 17).

In contrast, the Yamakita et al. reference is specifically directed to improving the response speed (paras. [0005] and [[0029]) through the conventional approach of analyzing the twist elastic coefficient (paras. [0006] - [0007]). This approach provides a preference for a cyano-based liquid crystal material (para [0008]). However, the cyano-based liquid crystal material has problems, so a fluorine-based liquid crystal material is used instead (para [0011]).

In particular, the Yamakita et al. reference's specific purpose is to prevent having to change the liquid crystal material from cyano-based to fluorine-based (para [0025]) and accomplishes that object by providing a display panel with a line width of at least one of a common electrode and the pixel electrode being larger than the gap between the common electrode and the pixel electrode (para. [0026]). A side effect of the solution disclosed by the Yamakita et al. reference is an alleged improvement in transmittance (para. [0033]).

In summary, the Yamakita et al. reference is directed to enabling the use of the cyano-based liquid crystal material so that a response speed and transmittance may be improved. Therefore, since the Yamakita et al. reference is directed to improving response time by enabling the use of a cyano-based liquid crystal and the AAPA is not directed to the problem of improving response time or enabling the use of a cyano-based liquid crystal material, one of ordinary skill in the art would not have been motivated to modify the teachings of the AAPA based upon the disclosure of the Yamakita et al. reference.

In the June 20, 2003 Office Action, the Examiner mischaracterizes Applicant's contention. The Examiner appears to believe that Applicant is contending that Yamakita is

directed only to improving response speed (top of page 8). However, as pointed out by the previous paragraph, the Applicant is merely pointing out that the problems addressed by the Yamakita et al. reference of enabling the use of the cyano-based liquid crystal material so that a response speed and transmittance may be improved is completely different from the problem addressed by the AAPA of low luminance derived from a low aperture ratio and the non-transparent comb-like electrodes and to avoid the complicated fabrication process of one conventional attempt to solve this problem. Thus, since these references are directed to different problems, one of ordinary skill in the art would not have been motivated to combine these references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner does not even support the combination by identifying a reason for combining the references.

The Examiner alleges that it would have been obvious to one of ordinary skill in the art at the time of the invention to include the liquid crystal layers having a splay elastic constant to be 9 and 12 pN in the display disclosed by the AAPA to "form a transparent electrode which allows the portions of the light located right above the electrodes to be used as a display portion, thus improving the transmittance (Yamakita page 2 last four lines)." However, Applicant respectfully submits that the Yamakita et al. reference does not teach that including a liquid crystal having a splay elastic constant to be 9 or 12 pN has anything to do with the ability to form a transparent electrode.

Rather, the Yamakita et al. reference discusses addressing two separate goals. As explained earlier, the first goal is to enable the use of a transparent electrode and the second goal is to enable the use of a cyano-based liquid crystal.

The Yamakita et al. reference explains that a "First Background Art" provides a display with contrast even without a transparent electrode (para. [0004]). The Yamakita et al. reference also explains that if a transparent electrode is provided that there are problems with transmittance (para. [0013]). The Yamakita et al. reference also discloses a "Second Background Art" with a transparent counter electrode 202 (para. [0016]) and explains that if both the counter electrode and the pixel electrode are transparent that the electric field strength is reduced and transmittance is adversely affected (para. [0021]). The Yamakita et al. reference later explains that by reducing the electrode spacing or increasing the thickness a transparent electrode may be used (paras. [0032] - [0033]).

Therefore, contrary to the allegations of the Examiner, the Yamakita et al. reference does not teach or suggest any relationship between the use of any liquid crystal material and the ability to use a transparent electrode. Rather, the Yamakita et al. reference discloses that the reduced line width and increased thickness of the electrodes enables the use of a transparent electrode. Thus, the Examiner's alleged motivation is simply not relevant to the use of any liquid crystal material.

In the June 20, 2003 Office Action, the Examiner attempts to contradict the fact that the Yamakita et al. reference does not teach or suggest any relationship between the use of any liquid crystal material and the ability to use a transparent electrode by reproducing text from paragraph 0133 of the Yamakita et al. reference. However, paragraph 0133 of the Yamakita et al. reference (including the portion reproduced by the Examiner) does not contradict the Applicant's assertion.

The Examiner appears to confuse a "liquid crystal display region" with a "liquid crystal material." The reproduced portion states "since transparent electrodes are used as the

electrodes of the present invention, the regions over the electrodes can be used as liquid crystal display regions." In other words, this portion of the Yamakita et al. reference is explaining that the use of transparent electrodes enables that portion of the liquid crystal display region which includes the transparent electrode to be used as opposed to the use of a non-transparent electrode which precludes the portion of the liquid crystal display region which includes the non-transparent electrode from being used. There is no mention at all about the type of liquid crystal material within the Examiner's cited paragraph 0133, let alone any mention at all of a relationship between the use of any liquid crystal material and the ability to use a transparent electrode.

Moreover, even assuming arguendo that one of ordinary skill in the art would have been motivated to combine these references, the combination would not teach or suggest each and every element of the claimed invention. Neither of the AAPA and the Yamakita et al. reference teach or suggest improving luminance by selecting a liquid crystal material having a splay elastic coefficient or a bend elastic coefficient to be within certain ranges. As noted above, the inventor discovered that low luminance is due not only to a low aperture ratio but also a weak anisotropy of refractive index of the liquid crystal layer.

In particular, the inventor realized that a portion of the local electric field in the liquid crystal of the pixel is vertical (normal) rather than parallel to the substrates (page 3, lines 1 - 11). As shown in Fig. 2, the local electric field in the periphery of the common/pixel electrodes 53/58 is not parallel to the substrate 300, rather it is more vertical. The liquid crystal molecules 370 in this portion are arranged in a splay pattern which lowers the luminance. While conventional display units (the AAPA) may have compensated for this problem by adjusting the twist elastic coefficient, neither of the splay elastic coefficient nor

the bend elastic coefficient were taken into account. Therefore, the present invention is directed to reducing the affect on luminance by restricting the splay elastic coefficient or the bend elastic coefficient for the liquid crystals (page 7, lines 4-5) and the AAPA does not teach or suggest these features.

Clearly, these novel features are also not taught or suggested by the Yamakita et al. reference. Indeed, the Yamakita et al. reference is completely unrelated to objects achieved by the claimed invention. As explained above, the Yamakita et al. reference is concerned with improving a response time and improving transmittance providing a display panel with a line width of at least one of a common electrode and the pixel electrode being larger than the gap between the common electrode and the pixel electrode (para. [0026]).

Additionally, the Yamakita et al. reference, like the AAPA, teaches that a response time may be improved by controlling the twist elastic coefficient (paras. [0005] - [0007]). Therefore, the Yamakita et al. reference does not teach or suggest the feature of the present invention of reducing the affect on luminance by selecting a liquid crystal material having a splay elastic coefficient and/or a bend elastic coefficient within a certain range to improve luminance.

In the June 20, 2003 Office Action on page 9, the Examiner again mischaracterizes the disclosure of the Yamakita et al. reference. The Examiner alleges that the Yamakita et al. reference discloses improving luminance by controlling the splay elastic coefficient and the bend elastic coefficient. In support for this allegation, the Examiner cites paragraph [0158] of the Yamakita et al. reference.

However, the portion of the Yamakita et al. reference merely sets forth the characteristics of one of the liquid crystal materials as having "Spray elastic constant of the

liquid crystal material of the liquid crystal layer 2 is k11 = 12 (pN), twist elastic coefficient is k22 = 7 (pN), bend elastic coefficient k33 = 18 (pN) and dielectric constant anisotropy is +8." This portion of the Yamakita et al. reference does not state any relationship at all, let alone a disclosure that luminance may be improved by selecting a splay elastic coefficient and a bend elastic coefficient.

This portion of the Yamakita et al. reference also points out that "The dielectric constant anisotropy and the bend elastic constant k33 are important factors in determination the drive voltage of the liquid crystal." This portion of the Yamakita et al. reference does not mention any affect at all upon luminance. Rather, this portion of the Yamakita et al. reference states that the dielectric constant and the bend elastic constant are important factors in determination of the drive voltage.

The remaining portion of the Examiner's reproduced section from the Yamakita et al. reference further states that "It is particularly preferable that the dielectric constant anisotropy is 8 or more and the end elastic coefficient k33 is 18 (pN) or less." This portion also does not mention any relationship at all, let alone an effect upon luminance. To the contrary, since this sentence follows immediately after a sentence which states that the dielectric constant and the bend elastic constant are important factors in determining drive voltage, that these preferred values improve the drive voltage.

Therefore, contrary to the Examiner's allegation, the Yamakita et al. reference does not teach or suggest selecting a liquid crystal material having a splay elastic coefficient and/or a bend elastic coefficient within a certain range to improve luminance.

Therefore, the Examiner is respectfully requested to withdraw this rejection of claims 1-27.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that claims 1-27, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: 9/22/03

James E. Howard
Registration No. 39,715

McGinn & Gibb, PLLC
8321 Old Courthouse Rd., Suite 200
Vienna, Virginia 22182
(703) 761-4100
Customer No. 21254